

# Health and Safety Plan for the Operable Unit 7-13/14 In Situ Grouting Treatability Study

## 1. INTRODUCTION

### 1.1 Purpose

This health and safety plan (HASP) establishes the requirements and controls that will be used to eliminate or minimize health and safety risks to persons conducting in situ grouting (ISG) project activities at the Cold Test Pit South and North areas located outside the fence of the Radioactive Waste Management Complex (RWMC). The ISG treatability study is being conducted to help determine possible treatment options for hazardous and radioactive waste forms buried in the Subsurface Disposal Area (SDA) of the RWMC.

This HASP governs all tasks associated with the ISG treatability study, including pregrouting activities, grouting, excavation, sampling, and post-excavation and sampling tasks. All tasks will be performed by employees of Bechtel BWXT Idaho, LLC (BBWI), subcontractors to BBWI, or other U.S. Department of Energy (DOE) laboratory personnel. Personnel not normally assigned to work at the Idaho National Engineering and Environmental Laboratory (INEEL), such as representatives of DOE, the state of Idaho, Occupational Safety and Health Administration (OSHA), and the U.S. Environmental Protection Agency (EPA), are not considered field team members and fall under the definition of “occasional site workers,” as stated in OSHA 29 *Code of Federal Regulations* (CFR) 1910.120/1926.65, “Hazardous Waste Operations and Emergency Response (HAZWOPER).”

This HASP has been prepared to meet the requirements of OSHA standard, 29 CFR 1910.120/1926.65. Its preparation is consistent with information found in the National Institute of Occupational Safety and Health (NIOSH)/OSHA/United States Coast Guard/EPA *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH 1985), INEEL Companywide Manual 14A, *Safety and Health – Occupational Safety and Fire Protection*, INEEL Companywide Manual 14B, *Safety and Health – Occupational Health*, PRD-183, *Radiation Protection – INEEL Radiological Controls Manual*, and INEEL Companywide Manual 15B, *Radiation Protection Procedures*. The ISG treatability study tasks have been screened in accordance with DOE Order 5480.21, “Unreviewed Safety Questions,” and have been determined to fall within the RWMC safety authorization basis, as outlined in the *Radioactive Waste Management Complex Safety Analysis Report* (INEEL 2000a), or are categorically excluded. Additionally, a hazard classification for grouting operations was conducted in the “Hazard Classification for the In Situ Grouting Cold Test” (Stepan 2001).

This HASP will be reviewed and revised by the project health and safety officer (HSO) in conjunction with the field team leader, necessary environmental, safety, and health professionals, and the environmental restoration (ER) Waste Area Group (WAG) 7 safety, health, and quality assurance (SH&QA) point of contact (POC) to ensure its effectiveness and suitability throughout the project.

### 1.2 Scope

The ISG treatability study will focus on evaluating the effectiveness of using ISG technology to encapsulate and stabilize mixed radioactive and radiologically contaminated waste and intermixed soil buried in the SDA and will be conducted in accordance with the *Implementation Test and Field Test Plan for the Operable Unit 7-13/14 In Situ Grouting Treatability Study* (Loomis et. al. 2001). Data from the study will be evaluated relative to abating risk to the Snake River Plain Aquifer and for general

implementability. The treatability study will examine only the long-term disposal option presented in the *Operable Unit 7-13/14 In Situ Grouting Treatability Study Work Plan* (DOE-ID 1999). The ISG option for confinement during retrieval also presented in the ISG Treatability Study Work Plan (DOE-ID 1999) is deferred to a separate treatability study or a post-Record-of-Decision action.

The ISG treatability study will be conducted in accordance with the general quality assurance procedures in the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites (QAPjP)* (DOE-ID 2000a). The activities outlined in this test plan also will be conducted in accordance with PLN-694, *Project Management - Environmental Restoration Project Management Plan*. Together, the QAPjP and PLN-694 establish the quality requirements of the INEEL Environmental Restoration Program (ERP).

### **1.3 Idaho National Engineering and Environmental Laboratory Site Description**

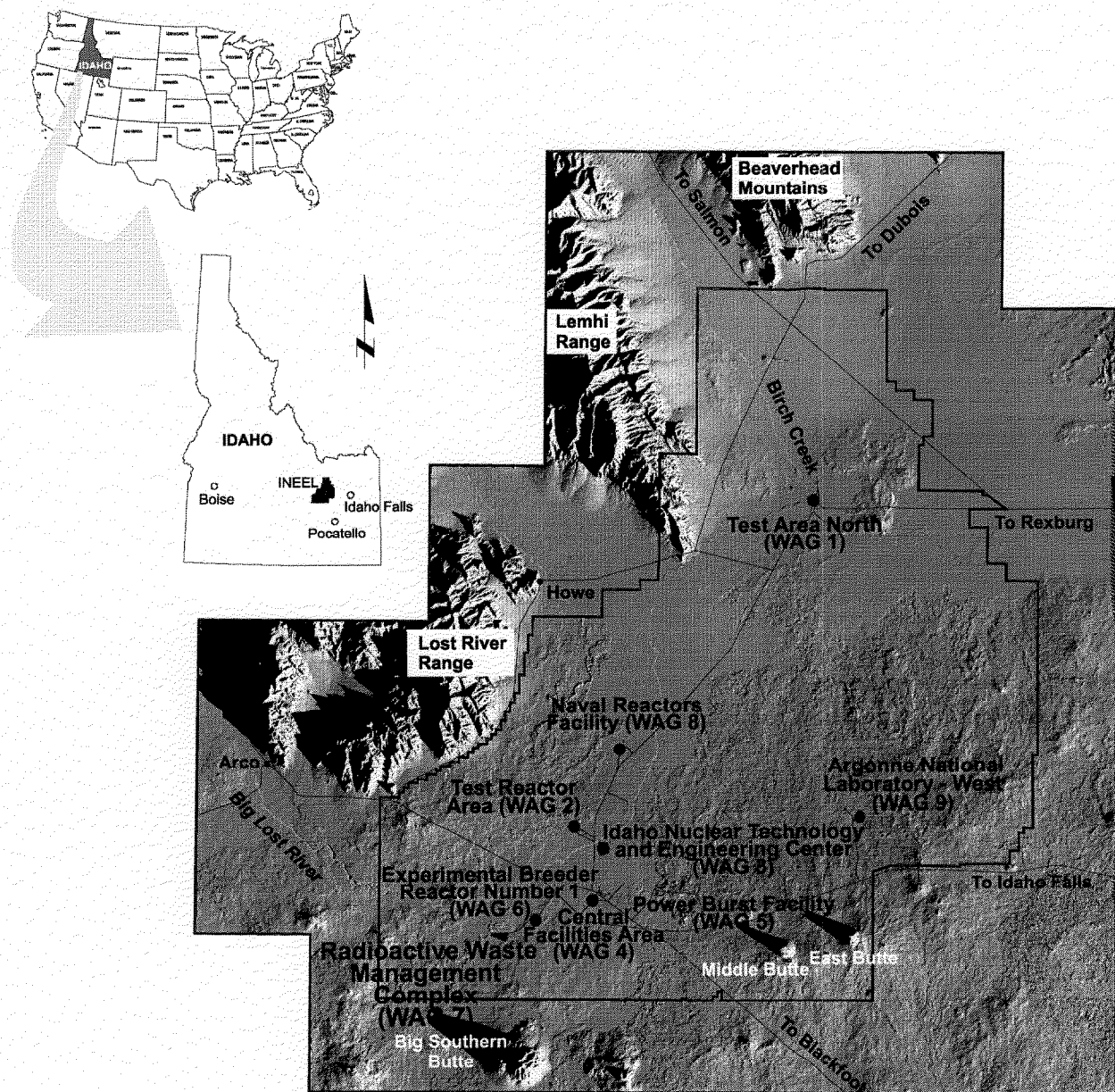
The INEEL, formerly the National Reactor Testing Station, encompasses 2,305 km<sup>2</sup> (890 mi<sup>2</sup>), and is located approximately 55 km (34 mi) west of Idaho Falls, Idaho (see Figure 1-1).

The United States Atomic Energy Commission, now the DOE, established the National Reactor Testing Station, now the INEEL, in 1949 as a site for building and testing a variety of nuclear facilities. The INEEL has also been the storage facility for transuranic (TRU) radionuclides and radioactive low-level waste since 1952. At present, the INEEL supports the engineering and operations efforts of the DOE and other federal agencies in areas of nuclear safety research, reactor development, reactor operations and training, nuclear defense materials production, waste management technology development, and energy technology and conservation programs. The U.S. Department of Energy Idaho Operations Office (DOE-ID) has responsibility for the INEEL, and designates authority to operate the INEEL to government contractors. Bechtel BWXT Idaho, LLC (BBWI), the current primary contractor for DOE-ID at the INEEL, provides managing and operating services to the majority of INEEL facilities.

#### **1.3.1 Radioactive Waste Management Complex**

The RWMC, located in the southwestern portion of the INEEL (see Figure 1-1), was established in the early 1950s as a disposal site for solid, low-level waste generated by INEEL operations. The RWMC encompasses 0.58 km<sup>2</sup> (0.23 mi<sup>2</sup>) and consists of two main disposal and storage areas: (1) the Transuranic Storage Area and (2) the SDA. Within these areas are smaller, specialized disposal and storage areas. The Transuranic Storage Area is an interim storage area where TRU waste is stored in containers on asphalt pads. The SDA is a 96.8-acres (39.2-ha) area where radioactive waste materials have been buried in underground pits, trenches, soil vault rows, and one aboveground pad (Pad A). Operable unit (OU) 7-10 (i.e., Pit 9) is located in the northeast corner of the SDA and is approximately 379 × 127 ft (116 × 39 m).

Rocky Flats Plant TRU waste was disposed in the SDA from 1952 to 1970, and low-level radioactive waste from 1954 through 1970. The Rocky Flats Plant, which is a DOE-owned facility that was used primarily for the production of components for nuclear weapons, is located 16 mi northwest of Denver, Colorado. In the mid 1990s, it was renamed the Rocky Flats Environmental Technology Site (RFETS), and in the late 1990s was renamed again, the Rocky Flats Closure Project, which is its present name.



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WAG 10 includes all sites, disposal areas, and portions of the Snake River Plain Aquifer that either are outside the boundaries of WAGs 1 through 9 or are not included within the other WAGs.

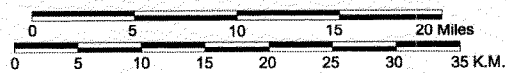


Figure 1-1. Location of the Radioactive Waste Management Complex at the INEEL.

A consent order and compliance agreement (COCA) was entered into between DOE and the EPA pursuant to the Resource Conservation and Recovery Act (RCRA), Section 3008(h), in August 1987 (DOE-ID 1987). The COCA required DOE to conduct an initial assessment and screening of all solid waste and hazardous waste disposal units at the INEEL and set up a process to conduct any necessary corrective actions. On July 14, 1989, the INEEL was proposed for listing on the National Priorities List (NPL) (54 FR 29820). The listing was proposed by the EPA, under the authorities granted to the EPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (42 USC § 9601 et seq.). The final rule that listed the INEEL on the NPL was published on November 21, 1989 (54 FR 48184). As a result of having the INEEL on the NPL list, the DOE, EPA, and Idaho Department of Health and Welfare entered into the Federal Facility Agreement and Consent Order on December 9, 1991 (DOE-ID 1991). Under the Federal Facility Agreement and Consent Order, the INEEL is divided into 10 WAGs. The WAGs are further subdivided into OUs. The RWMC has been designated as WAG 7 and consists of 14 OUs. Operable Unit 7-13/14 combines the scope and schedule for the OU 7-13 TRU pits and trenches remedial investigation/feasibility study (RI/FS) and the OU 7-14 comprehensive RI/FS for WAG 7.

### **1.3.2 Cold Test Pits**

The cold test pits have been used to identify, evaluate, and demonstrate various innovative technologies for the remediation of radioactive and hazardous waste buried throughout the DOE complex. The cold test pit area was selected as a test area because it was free of hazardous materials and radiological contaminants and had soil characteristics and depth requirements identified in the design analysis. The design and construction features of this area simulate the TRU waste pits and trenches located in the RWMC SDA. Storage tanks, waste boxes, cardboard drums, and concrete culverts have been used as containers for simulated waste. The nonhazardous, nonradioactive simulated waste pit area is used to demonstrate characterization, retrieval, and treatment technologies that may be useful for remediating buried waste. The simulated waste pit provides known targets and waste forms for accurate evaluation and calibration of procedures, technologies, and equipment. Testing at the cold test pit reduces hazards to personnel and the environment that otherwise would be unavoidable in an actual disposal area.

**1.3.2.1 Cold Test Pit South.** The Cold Test Pit South, located 200 yd (183 m) south of the RWMC boundary, was established in 1988 and has been used for many treatability studies. Some containers from past studies remain buried at the Cold Test Pit South. The Cold Test Pit South has been identified as a DOE complex resource for verification and validation of geophysical equipment and systems. A majority of the Cold Test Pit South is open ground and covers approximately 10 acres (4 ha) (see Figure 1-2). Support trailers, a wood storage shed, and a soft-sided tent (weather structure) are located at Cold Test Pit South. A dedicated weather structure will be constructed for the ISG field test project. The weather structure will not be used for grouting at any of the Cold Test Pit North locations.

**1.3.2.2 Cold Test Pit North.** The Cold Test Pit North is located north of the SDA, outside the existing RWMC fence line. The area has been supplied with power for the field-scale tests. A pit has been constructed to simulate SDA waste forms (see Figure 1-3)<sup>a</sup>. The dimensions for the simulated waste seam in the pit are approximately 5.5 × 5.5 × 3.4 m (18 × 18 × 11.2 ft) deep with an underburden thickness of at least 0.6 m (2 ft) and an overburden thickness of 2.1 m (7 ft). The simulated Series 74 sludge in the pit will contain inorganic sludges, organic sludges, and nitrate salts that simulate the bulk makeup of the Series 74 sludges presently buried in the SDA. In addition, a 1.2-m (4-ft) deep trench, 1.2 m (4 ft) wide × 4.6 m (15 ft) long, has been placed at the top of the waste seam, extending off one side of the pit. The trench is filled with a close-packed arrangement of 10 nitrate salt drums, 5 organic sludge drums, and 7 cardboard boxes of combustible waste.

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a. Construction of CTP-N has already been completed, and is, therefore, not addressed in this HASP.

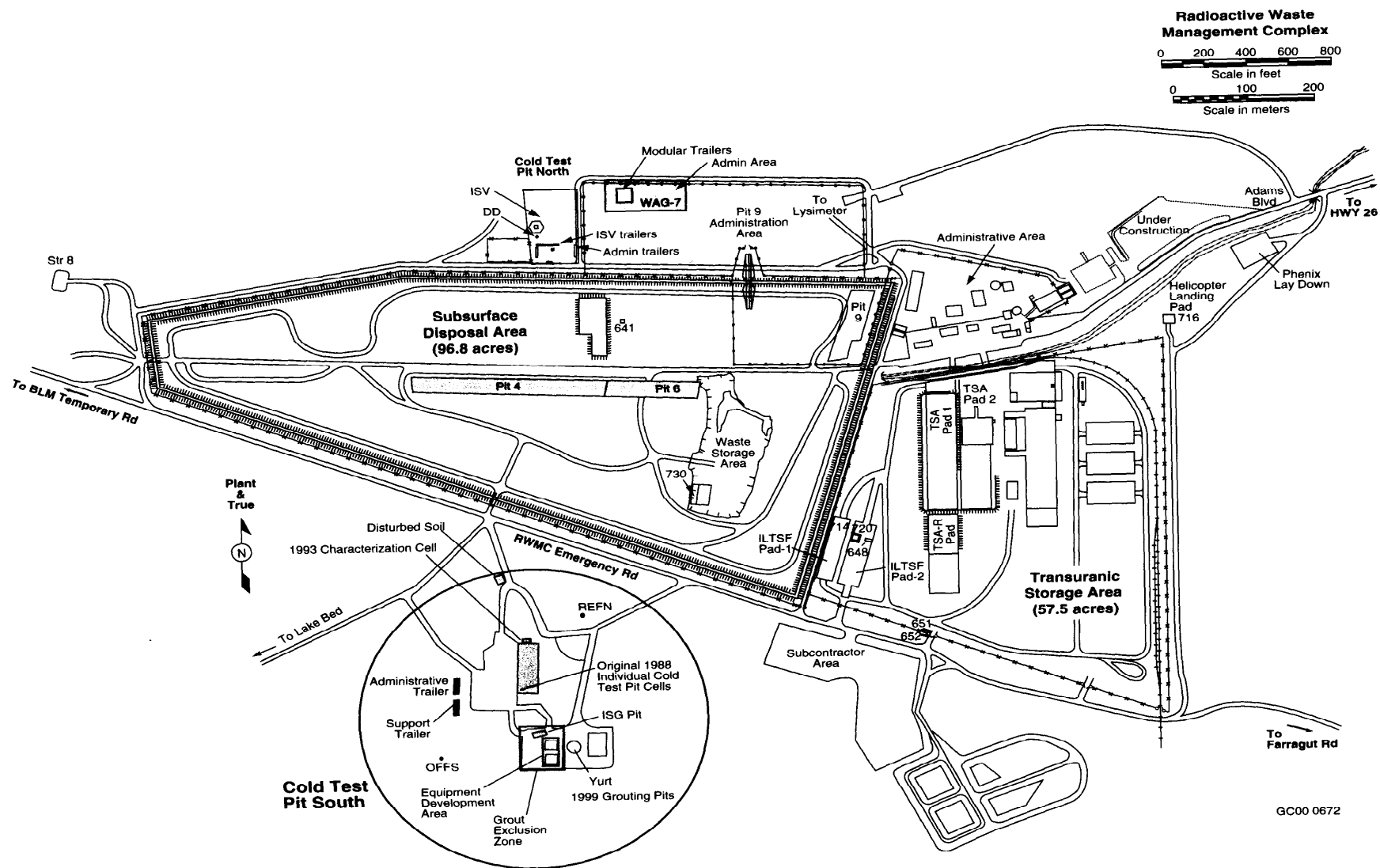


Figure 1-2. Cold Test Pit South.

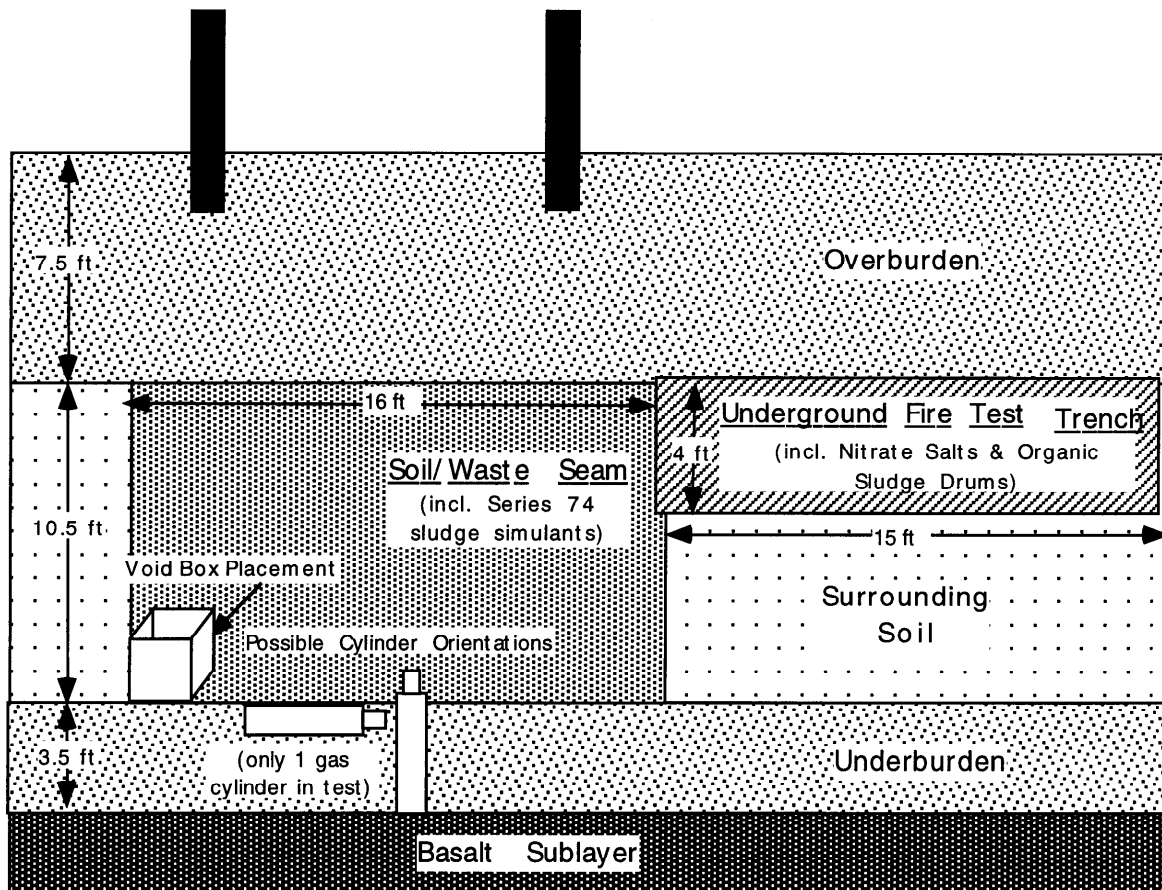


Figure 1-3. Cold Test Pit North simulated waste pit.

## 1.4 Field Tests

The ISG field tests will primarily evaluate the implementability and effectiveness of the technology at a full-scale testing arrangement that simulates the types of conditions expected at the SDA. Tests will include grouting for long-term disposal. Test results from sampling and evaluation of the field monolith will be compared with bench-scale data to consider changes in grout properties caused by blending with the SDA soil-waste matrix.

Field tests involve four basic tasks:

- Test area preparation
- Grout emplacement
- Post-grouting noninvasive monolith evaluation
- Post-grouting destructive examination and evaluation.

### 1.4.1 Test Area Preparation.

Initial test area preparation tasks for the full-scale demonstration will include surveying the site and constructing simulated waste pits. Pits will simulate statistically average conditions for the SDA and closely represent similar soil types, mineralogy, permeability, and waste deposition. The three test areas that will be grouted at Cold Test Pit South and Cold Test Pit North have been constructed (see Figures 1-4 and 1-5). In Figure 1-4, the test area is indicated as the proposed ISG area and in Figure 1-5, the test areas comprise the ISG Pit and the field parameters. Details of the pit construction and design rationale are documented in the *Implementation Test and Field Test Plan for the Operable Unit 7-13/14 In Situ Grouting Treatability Study* (Shaw 2000).

**1.4.1.1 Simulated Waste Preparation.** A combination of SDA-wide waste volumes and specific details of Pit 6 at the SDA were used as a model for defining the simulated waste container volumes and waste material. Pit 6 was chosen as a model primarily because its waste content ratios and 8 ft (2.4 m) average depth of buried waste are both approximate averages for the SDA, which simplifies the retrieval process for the treatability study. Table 1-1 shows the SDA-wide volume of buried waste and the fraction of the total for each of the following seven major categories:

- Combustibles
- Organic sludge
- Inorganic sludge
- Nitrate sludge
- Metal
- Concrete
- Asphalt.

Table 1-2 shows that the waste volume in Pit 6 equals approximately 50% of the excavated volume of buried waste in the SDA. Of the total volume, 46% is drummed waste (55-gal [208-L] drums), 33% is boxed waste (wooden 4- × 4- × 8-ft [1.2- × 1.2- × 2.4-m] boxes), and 21% is cartoned waste (cardboard boxes of combustible material).

Applying the SDA waste-loading rationale (presented in Tables 1-2 and 1-3) to a 15 × 15 × 8-ft (4.5 × 4.5 × 2.4-m) deep test pit area, two 4 × 4 × 8-ft (1.2 × 1.2 × 2.4-m) boxes, 49 fifty-five-gal (208-L) drums, and 14 nominal 2 × 2 × 3-ft (0.6 × 0.6 × 0.9-m) polyethylene sacks will be randomly configured in the test pit. Table 1-3 summarizes information relative to the type and contents of the simulated waste packages for the disposal pit. Metal debris, including plate steel, tubing, and scrap metal, will be hand-placed in two of the boxes along with concrete, asphalt, and wood. Boxes will contain approximately 38% metal, 37% concrete and asphalt, and 25% wood. Of the 49 drums, 25 will contain combustibles that include cloth, paper, wood, and plastic, 13 will contain inorganic sludge, 6 will contain organic sludge, and 5 will contain nitrate salts. The 14 polyethylene sacks will be filled with cloth and paper. A terbium oxide tracer will be placed in each container (except for the nitrate drums) to simulate the mechanical movement of plutonium during operations. The combustible drums will contain 3.5 oz (100 g) of tracer, the boxes 14 oz (400 g), the inorganic drums 7 oz (200 g), the organic drums 1.75 oz (50 g), and the sacks 3.5 oz (100 g).

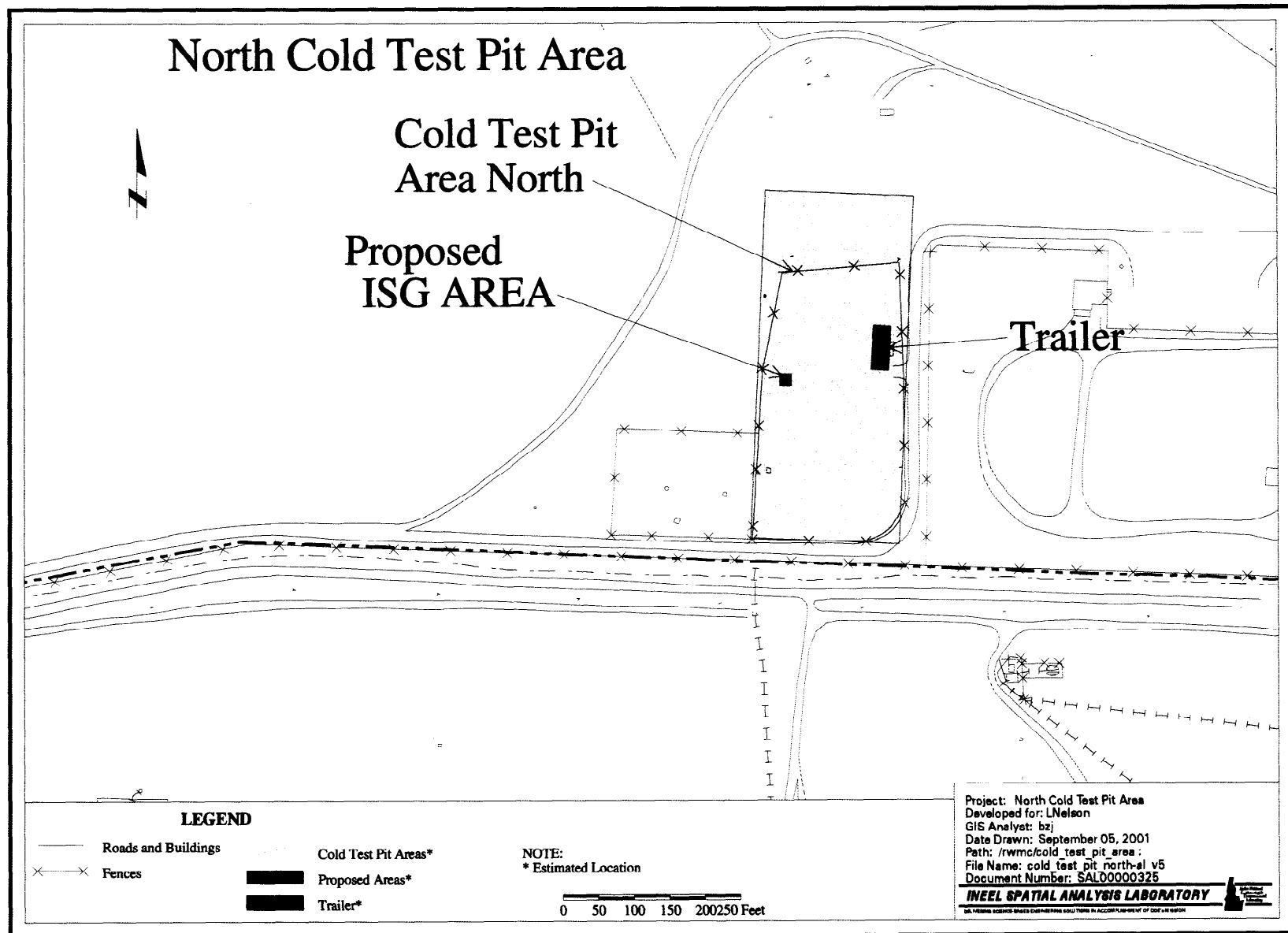
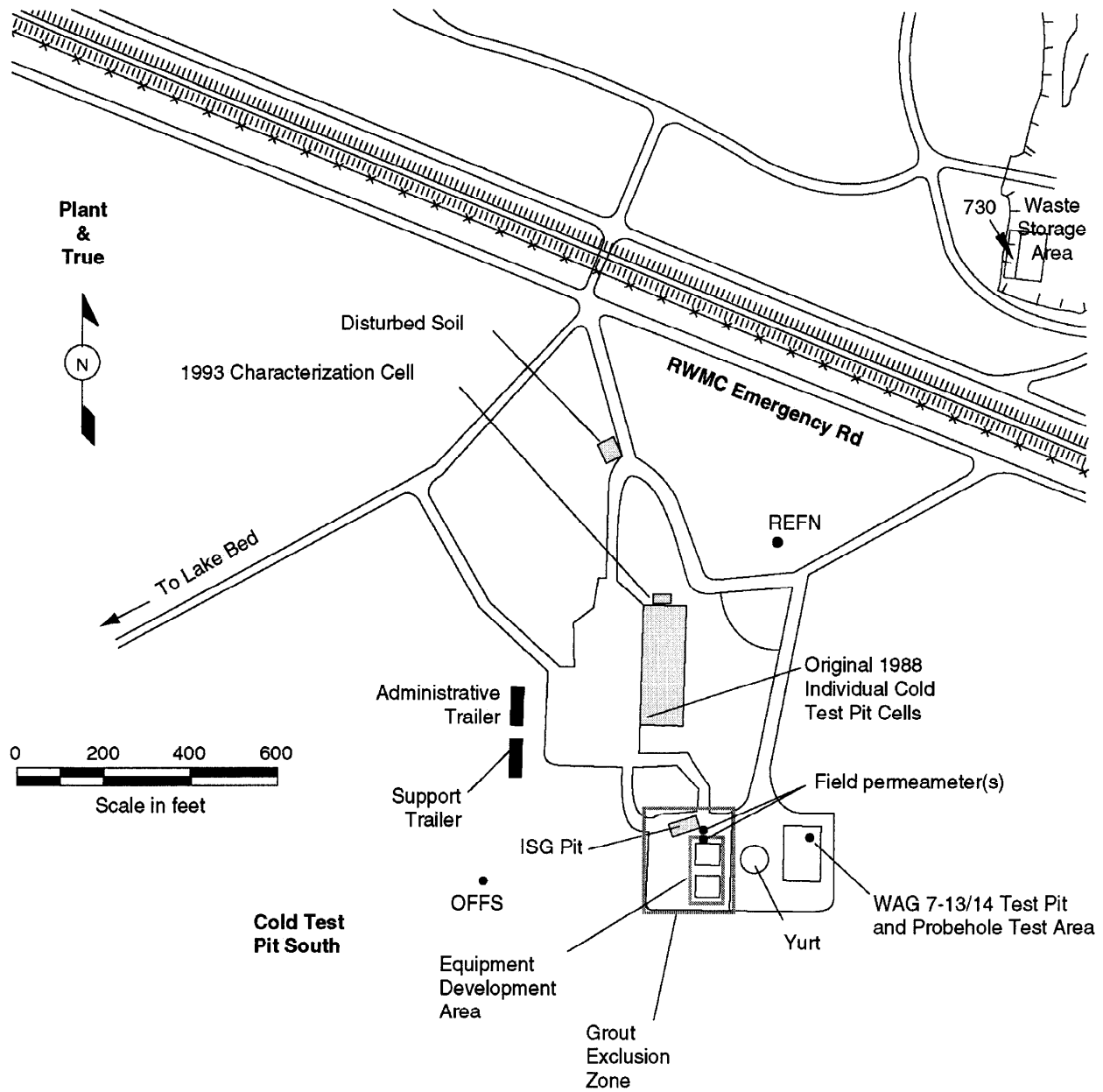


Figure 1-4. Map of the Cold Test Pit North showing facilities, roads, and fences.





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Figure 1-5. Map of Cold Test Pit South showing facilities, roads, and fences.

Table 1-1. Volume fractions of buried transuranic waste in the Subsurface Disposal Area.

Waste Type	Volume (m <sup>3</sup> )	Fraction of Total
Organic	3,696	0.059
Nitrate	2,480	0.043
Inorganic	7,361	0.124
Brick and concrete	7,570	0.117
Metal	7,445	0.121
Combustible	33,480	0.536
Total	62,032	1.000

Table 1-2. Pit 6 waste and soil volumes.

Total Excavated Volume	Total Soil Volume	Total Waste Volume
447,515 ft <sup>3</sup> (12,672 m <sup>3</sup> )	223,617 ft <sup>3</sup> (6,332 m <sup>3</sup> )	223,898 ft <sup>3</sup> (6,340 m <sup>3</sup> )
Waste Type	Volume of each waste type	Fraction of Total
Drums	102,272 ft <sup>3</sup> (2,896 m <sup>3</sup> )	46%
Boxes	73,918 ft <sup>3</sup> (2,093 m <sup>3</sup> )	33%
Cardboard	47,708 ft <sup>3</sup> (1,351 m <sup>3</sup> )	21%

Table 1-3. Simulated waste packages for the disposal pit.

Waste Container Type	Number	Composition
Cardboard boxes (4 × 4 × 8 ft)	2	Metal debris (1/8-in. plate steel, tubing, piping, and scrap metal), concrete and asphalt chunks (6-in. size), and pulverized wood. Total distribution percentage: metal 38%, concrete and asphalt 37%, and pulverized wood 25%
55-gal drum	25	Combustibles (i.e., cloth, paper, wood, and plastic)
55-gal drum	13	Inorganic sludge (enough water to create a pastelike consistency; 390 pounds mass (lbm) soil, 40 lbm dry Portland cement, and 36 lbm NaNO <sub>3</sub> )
55-gal drum	6	Organic sludge (38 gal of Texaco Regal Oil; 65 lbm MicroCell-E; 35 lbm kitty litter)
55-gal drum	5	Nitrate salts (granular: 60 wt% NaNO <sub>3</sub> , 30 wt% KNO <sub>3</sub> , 5 wt% Na <sub>2</sub> SO <sub>4</sub> , and 5 wt% NaCl)
Sacks (2 × 2 × 3 ft) (polyethylene)	14	Cloth, paper.

**1.4.1.2 Construction of Waste Pit.** Except for a few specific containers and drums at the Cold Test Pit North, the simulated waste containers were placed in the test pits in a random orientation, simulating the random dumping that occurred within the SDA. Figure 1-6 shows the general design features of the ISG disposal pits, including a 2-ft (0.6-m) compacted soil underburden, a 3-ft (0.9-m) overburden, a seam of simulated waste and soil 8 ft (2.4 m) thick, and a standard thrust block approximately 17 in. (43 cm) thick with space for grout returns. Pit dimensions vary at each location.

Figures 1-7 through 1-10 show the general layout of the waste containers superimposed on the thrust block grid, and identify the nominal grout hole patterns and location of the hydraulic conductivity wells. Figure 1-6 shows the thrust block with nominal, 20-in. (51-cm) spacing between grout holes, as used in the acid pit stabilization project.

Each figure represents an approximate 2-ft (0.6-m) axial slice of the pit. Figure 1-7 depicts the bottom 2 ft (0.6 m) of the pit, Figure 1-8 depicts the middle layer, 2 to 4 ft (0.6 to 1.2 m) from the bottom, Figure 1-9 depicts the layer 4 to 6 ft (1.2 to 1.8 m) from the bottom (which includes a nitrate drum and an organic drum penetrated by grout holes to be used as hydraulic conductivity wells), and Figure 1-10 depicts the layout of the top layer, 6 to 8 ft (1.8 to 2.4 m) from the bottom of the pit.

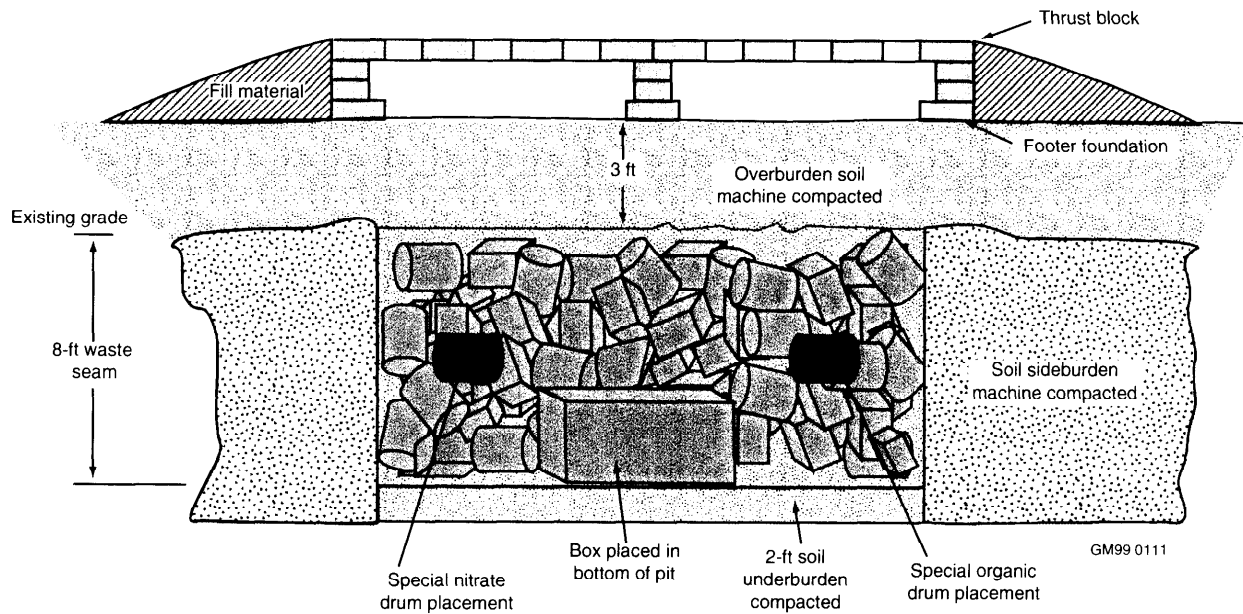
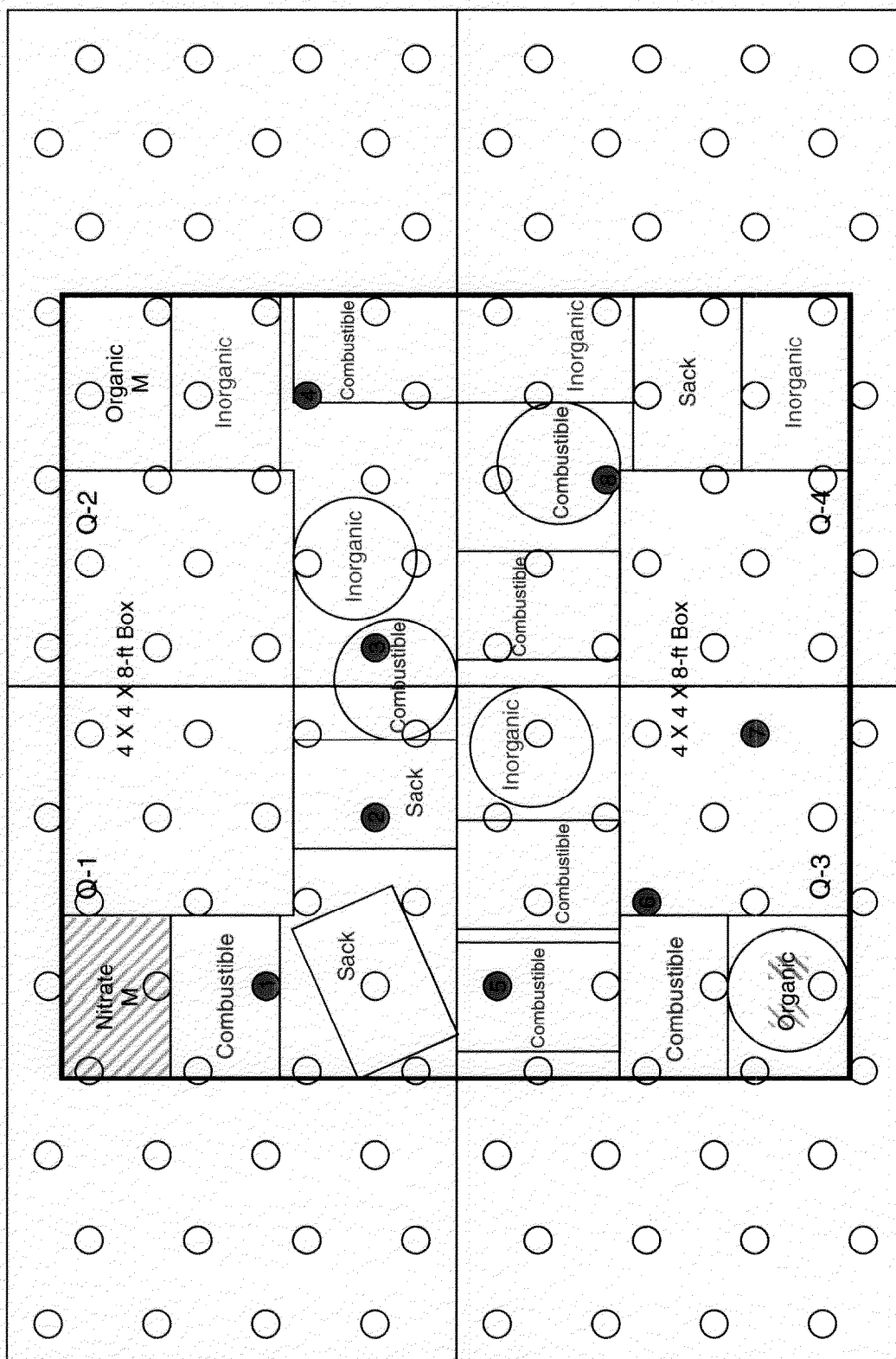


Figure 1-6. Design features of the in situ grouting long-term disposal pit.

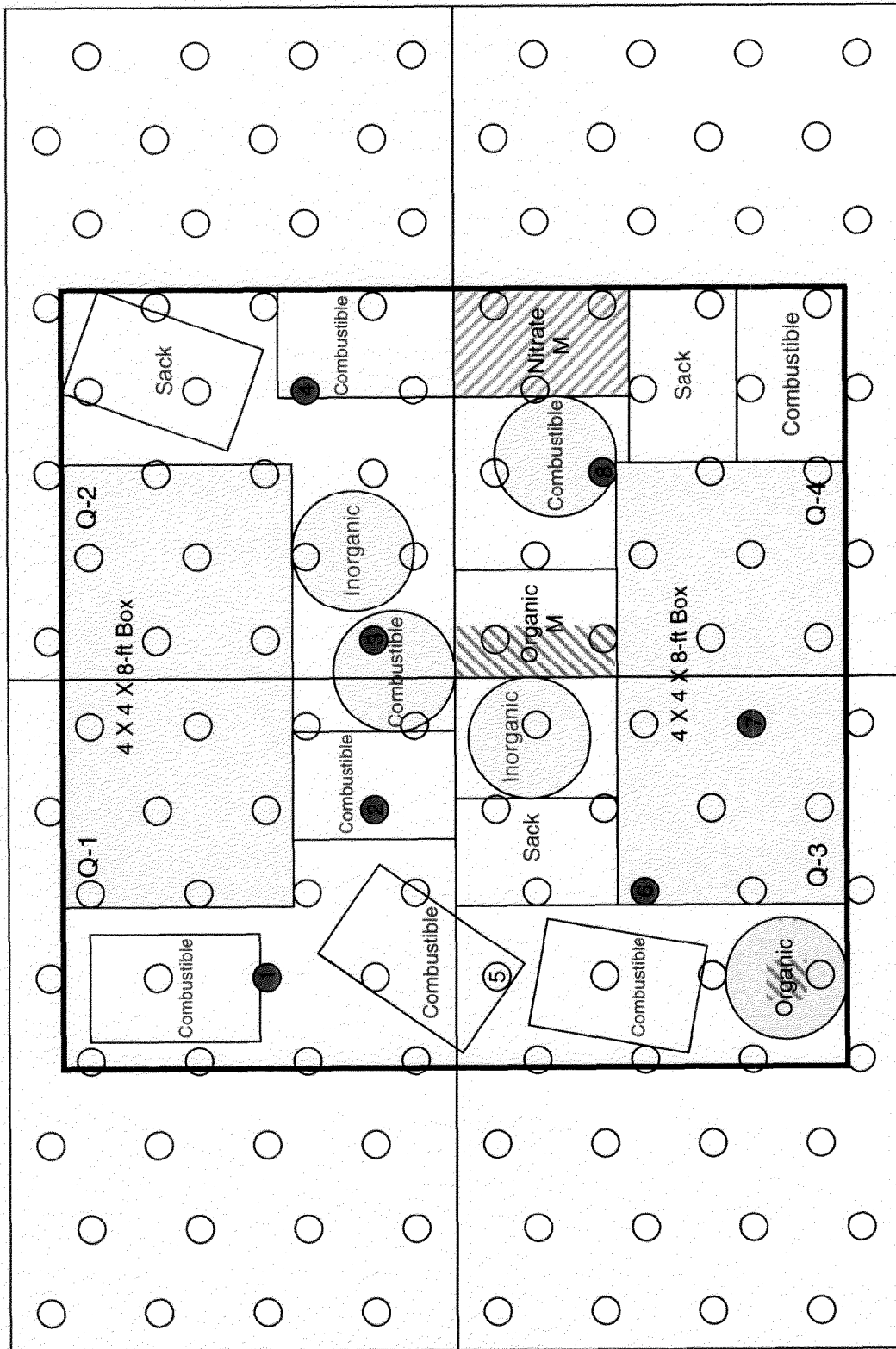
# Layer 1 Long-Term Disposal



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Figure 1-7. Layout of bottom layer, 0 to 2 ft (0 to 0.6 m) from the bottom of the pit.

# Layer 2 Long-Term Disposal



GC00 0211 2

Figure 1-8. Layout of middle layer, 2 to 4 ft (0.6 to 1.2 m) from the bottom.

Figure 1-9. Layout of middle layer, 4 to 6 ft (1.2 to 1.8 m) from the bottom.

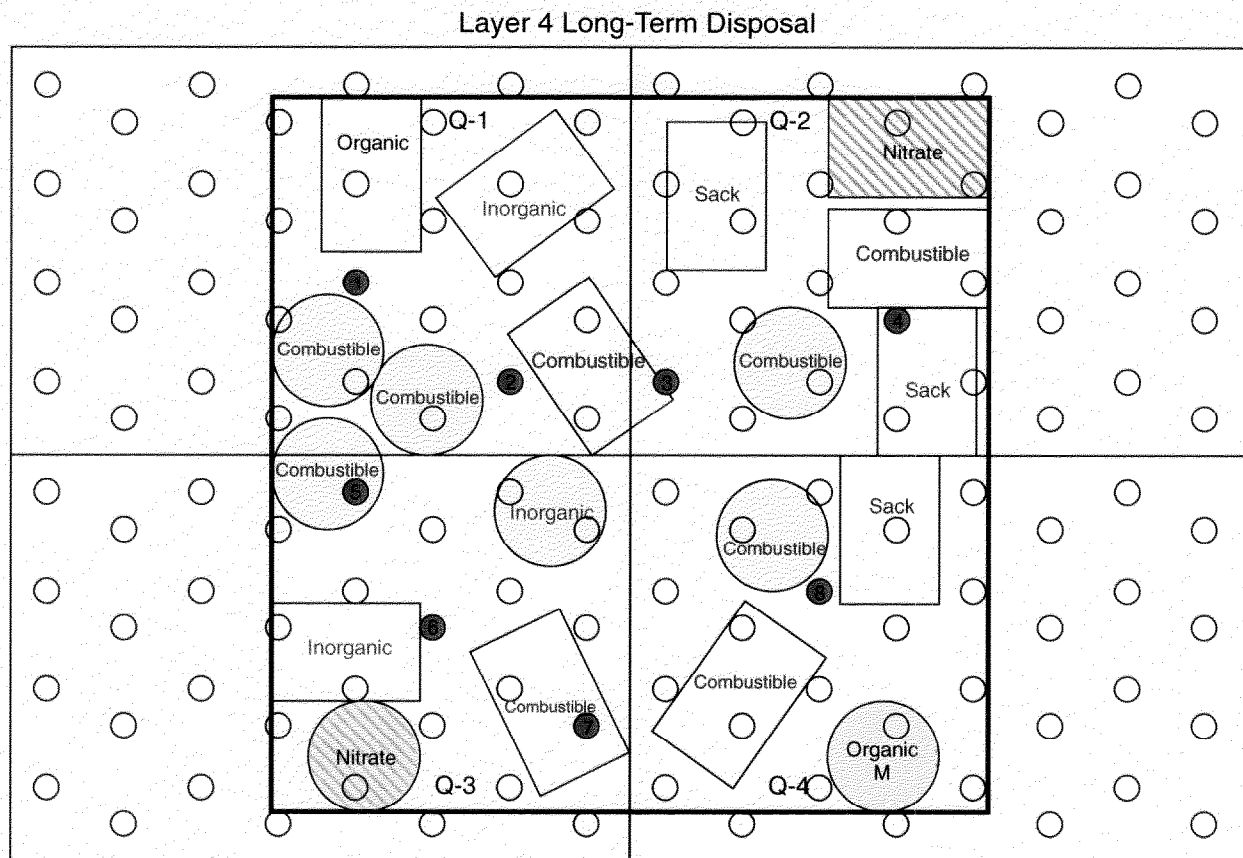


Figure 1-10. Layout of top layer, 6 to 8 ft (1.8 to 2.4 m) from the bottom.

Though the general design of the pit simulates a random dump, a berm buildup method will be employed in which the pit will be built from the bottom up with a berm around the outside dimensions of the pit. This method allows the layered placement of each drum for effective post-grouting evaluation. The top dead center of all drums will be surveyed following placement. Once built, the thrust block will be placed over the pit such that one drill hole location will penetrate the specially located nitrate and organic drums located in the middle layer (4 to 6 ft [1.2 to 1.8 m]) of the pit. This is important for post-grouting hydraulic conductivity testing and thermocouple placement.

#### 1.4.2 Grout Emplacement

The field test will provide data for evaluating the jet-grouting apparatus, field operations, grout mixing and delivery logistics, contamination control equipment and measures, thrust block stability and functionality, equipment troubleshooting measures, equipment laydown process, and transfer operations from one grout hole to another.

#### 1.4.3 Contamination Control

Thrust block panels will be placed over the test pit at Cold Test Pit South to control grout returns and provide a level working surface for the jet-grouting rig. A foundation layer of crushed gravel will be placed on the top of the simulated waste pit to help eliminate sinking of the thrust block panels. The pits will be surveyed and the corner positions and elevations established. The survey will be in accordance

with INEEL procedures and the pits will be measured to a minimum of  $\pm 3$ -in. ( $\pm 8$ -cm) increments. Markers will be placed on the pit to identify the position and location of the thrust block installation.

Preconstructed thrust block panels will be delivered and placed on surveyed test sites. The thrust block will be approximately 12 to 17 in. (30 to 43 cm) high, with an access hole pattern to allow for ample overlap to ensure the grouted columns merge into a solid form. Access holes constructed in the thrust block (for inserting the drill stem) are actually part of the contamination control system. These access holes will be nominally 6 in. (15 cm) in diameter and spaced in a grid pattern of 20 in. (51 cm) apart on centers.

Access holes will be fitted with several specialized features to prevent the spread of contamination above the thrust block, as shown in Figure 1-11. A major design criterion is ensuring zero release of finely divided rare earth tracer that simulates the plutonium particulate. Features that prevent the spread of contamination include caps over unused holes, a rubber seal, a double plastic bag-out sleeve, a video grout-returns monitoring system, temperature, humidity and air pressure monitoring suite, and a brushlike material to assist in cleaning the drill string as it is extracted. Figure 1-11 shows the basic design of the thrust block panel. A high-efficiency particulate air (HEPA) filtration system will be attached to the thrust block to create a small amount (nominally 1 in. [2.5 cm] of water) of negative pressure under the block and within the drill string shroud when attached to the block via the bag-out sleeve.

A basic drilling and grouting system (i.e., Casa Grande) will be modified to include special contamination control equipment. This equipment (shown in Figure 1-12) will eliminate or reduce the spread of particulate from the rotating drill stem during grouting. This special equipment includes an enclosure (or shroud) around the drill stem and associated mounting brackets. It also includes a special double O-ring seal at the top of the shroud and an airtight seal bracket for the bag-out system.

The double plastic sack sealed to the thrust block is connected to the drill string assembly via the double O-ring seal. The system is in the drilling and grouting mode with the drill steel extended through the thrust block hole, puncturing the diaphragm. Following the post-grout withdraw of the drill stem, the plastic sack is twisted and double-taped, similar to a radiation health physics bag-out procedure. The tape is cut, the excess sealed plastic bags are placed into the just-grouted hole, and the cap is replaced. The drill rig is then moved to a new hole position.

The space under the thrust block is designed to collect grout returns. During the moving operation, the small flow of grout (called "trickle flow") in the drill steel will be allowed to drain so that excess fluid does not accumulate in the plastic sack at the twist point. After the drill stem is positioned directly over the next hole, the cap in the thrust block is removed and the double plastic sack is extended from the thrust block over the guide tube and sealed with the O-ring seal, as shown in Figure 1-12. Once positioned, the drill stem is once again extended through the access hole and the drilling and grouting process is repeated.

After placement of the thrust blocks, a weather structure will be erected over the Cold Test Pit South to permit accurate monitoring of potential simulated airborne contaminants during grout emplacement. In past experiments, collecting airborne tracer spread during windy days in southeast Idaho was impossible, therefore, the weather structure is mandatory. Seven air samplers will be stationed along the perimeter of the test area and continuously run to test for airborne contaminants. Various air sampling and swipe data will be used to evaluate the effectiveness of the contamination control system.

Access driveways and turnaround traffic lanes for supply and equipment trucks and jet-grouting rig checkouts will be established, depending on test setup orientation and access to existing paths.



# Thrust Block Design Features

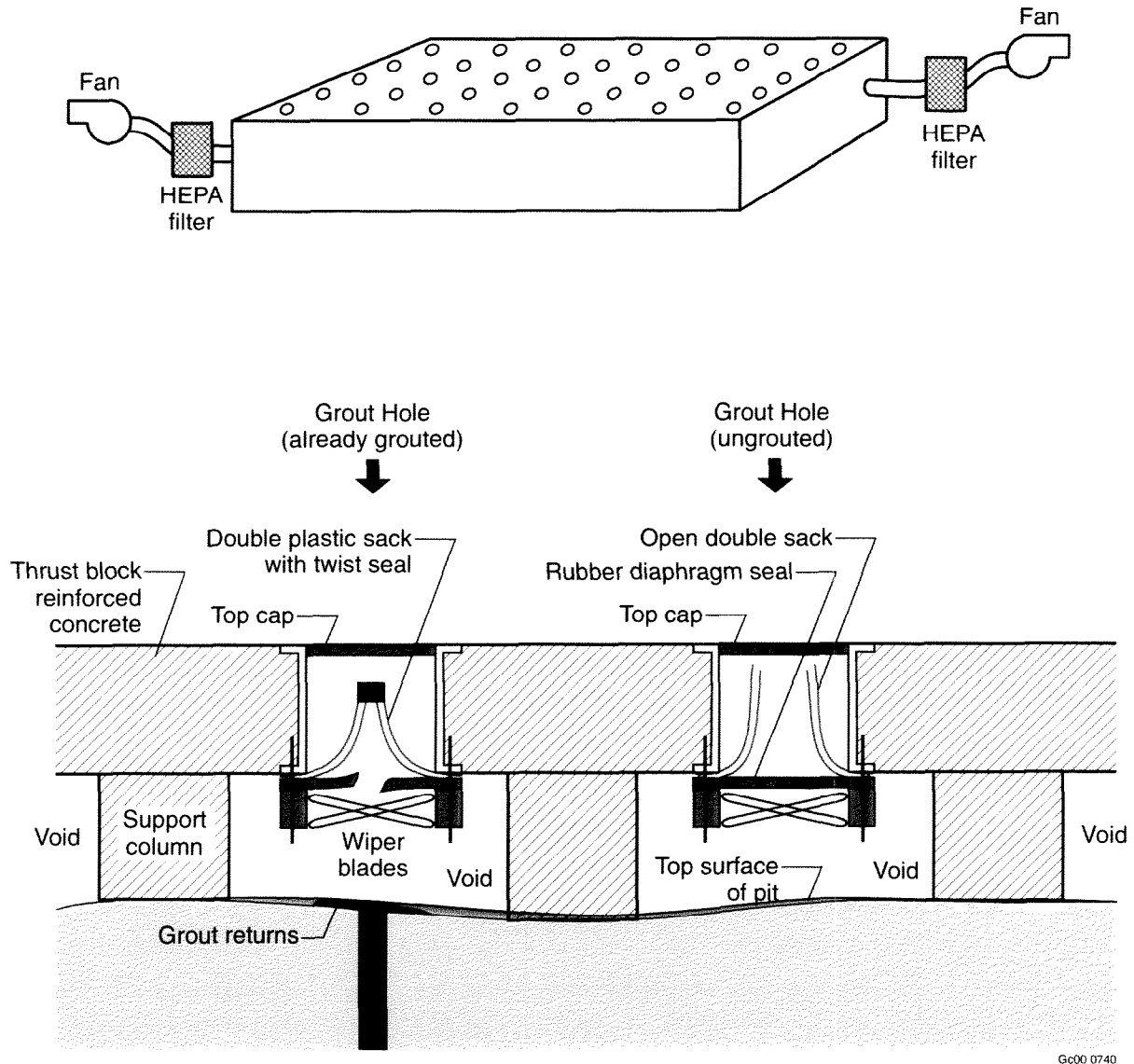
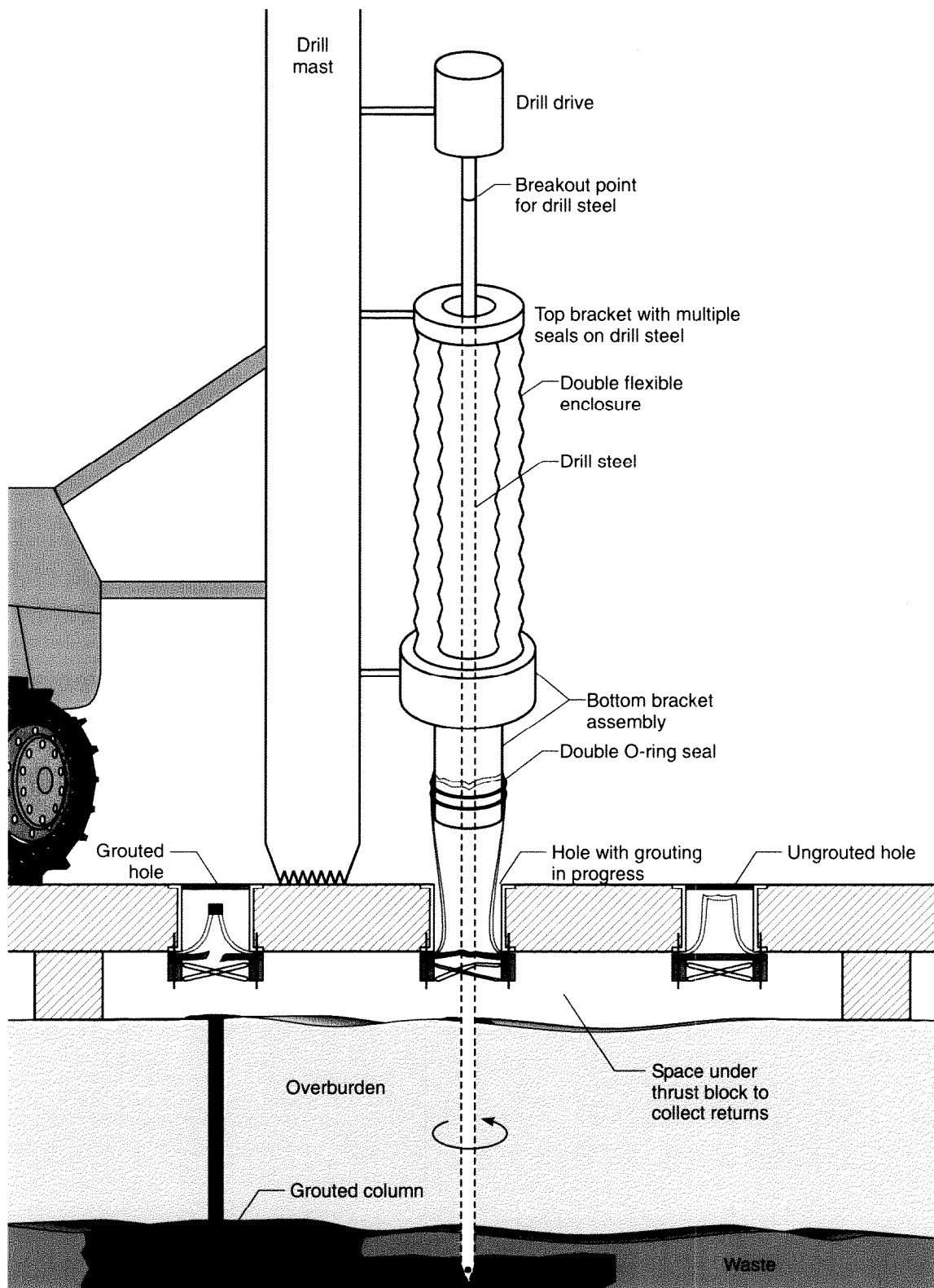


Figure 1-11. Features of the contamination control system for the grouting apparatus.



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Figure 1-12. Drill rig contamination control features.

For easy access, the jet grouting apparatus, drilling rig, and supply equipment (i.e., mixers, high-pressure pump, transfer pump, grout supply lines, exhaust lines, grout supply tanks, and water tanks) will be staged (prior to initiating grouting operations) in an area outside the designated work area. For the field study, the weather structure will be the controlled work area. This will minimize the need for personnel and equipment to enter the controlled work area. The jet-grouting apparatus initially will be staged outside the controlled work area for equipment setup and checkouts and moved inside the designated work area during grouting.

A laydown area will be established for the placement of used materials (e.g., cleanout water, unused grout, drill bits, drill strings, assemblies, and nozzles) until the grouting is completed. Designated work areas will be established and properly delineated. All restrictions for entering these areas will be posted, and daily briefings will inform workers of procedures for working in these areas. Section 7 describes site access and control in detail.

#### **1.4.4 Emplacement Preparation**

The field test will provide data for evaluating the jet-grouting apparatus, field operations, grout mixing and delivery logistics, contamination control equipment and measures, thrust block stability and functionality, equipment troubleshooting measures, equipment lay-down process, and transfer operations (including the thrust block features) from grout hole to grout hole.

The grouting rig and support equipment and materials will be staged in designated areas. After equipment staging, the system will be checked to ensure proper operation before grouting. Checks include:

- Checking calibration of grout flow meters
- Setting initial grouting parameters (i.e., step distance, step rate, and drill stem rotation)
- Testing contamination control equipment
- Flushing pumps and the drill system to remove residual materials
- Checking the thrust block HEPA system, temperature and relative humidity measurement system, and visual TV-camera system.

It is anticipated that grout mixing will occur at an onsite batch plant, but mixing at an offsite batch plant is also possible. Batch samples will be collected directly from the mixer (e.g., concrete truck or batch plant) before grouting and tested for viscosity and density. Other samples of “neat” grout will be obtained in cylinders for post-grouting physical and chemical testing.

After material testing and grout acceptance, the jet-grouting rig will be positioned over a cleanout trough to remove water from the system. After checkouts have been completed and the jet-grouting apparatus has been properly positioned over the thrust block with contamination control measures properly in place, the grouting process can be started. All grouting will be done at nominally two revolutions per step. Planned injection pressure is 6,000 psi. These parameters may vary depending on grout material used, equipment checkout tests, and other optimization determinations learned from the implementability test.

### 1.4.5 Grouting Operation

To begin the grouting operation, the jet-grouting rig is positioned over the thrust block access hole. The hole plug is then removed, and the double plastic sleeve, which is attached with the O-ring sleeve, is extended above the thrust block. The drill stem is extended through the thrust block and diaphragm to the ground surface into the gravel under the thrust block. A low-pressure trickle flow of grout is started and the hole is then drilled to the designated depth, which will be determined based on subassembly and drill bit geometry.

It is expected that grouting will start nominally at the bottom of the waste seam and extend nominally to above the waste seam. When total depth is reached, high-pressure grout injection will begin and the drill stem will be retracted to a prescribed depth, at which point high-pressure pumping will stop. The drill stem will be retracted into the space under the thrust block and allowed to drain. The drill stem will then be raised above the level of the core barrel. The double bag will be twisted off, the twist-off portion will be taped or banded, and the taped section will be cut. The lower half of the plastic sleeve will be placed in the hole and the hole plug will be replaced.

If refusal of the drill stem will not allow penetration to the total prescribed depth, the elevation will be noted and jet grouting will start at the refusal point without raising the still-rotating drill string. Grouting will continue for a period of time equal to the time that would have elapsed during normal jet grouting between the bottom of the pit and the point of refusal.

If at any time the TV camera system under the thrust block shows excessive grout returns, grouting should be discontinued (i.e., pressure dropped) and the principal investigator (PI) and grouting contractor will decide how to proceed.

**1.4.5.1 Placement of Hydraulic Conductivity Boreholes.** A series of boreholes will be created in the pit using 2.5- to 2.75-in. (6.35- to 6.98-cm) polyethylene rods placed in selected grout holes immediately following grouting. The polyethylene rod will be pushed through the twisted sack in the just-grouted hole and sealed with viscous liquid sealer. After the pit has cured, the polyethylene rods will be removed by backhoe, thus leaving an open hole. The hole will be sealed at the top with plastic sheeting to keep moisture out prior to conducting hydraulic conductivity tests in these boreholes. Additionally, a series of thermocouples will be placed using the same technique.

**1.4.5.2 System Cleanout.** Grouting will continue until system shutdown or cleanout is required. This may be at the end of a work-shift day or after system failure or a facility emergency. Prior to shutdown, whether after completing the day's work or after a breakdown, the jet-grouting apparatus will be flushed and cleaned to remove unused grout and water. The *Test Plan for the Operable Unit 7-13/14 Implementability and Field Testing In Situ Grouting Treatability Study* (Loomis et al. 2001) describes this process in greater detail. The basic cleanout process is described below.

1. The drill stem assembly is removed by breaking out the drill stem at the top of the apparatus and the mast is lowered and the drill stem is extended to expose the breakout joint.
2. Water is run into the transfer pump to begin flushing, which pumps under low pressure (50 to 100 psi). The flush is continued until clear water is seen discharging into the cleanout tank or pit.
3. The cleanout sub-hose is then disconnected. The low- and high-pressure pumps are dismantled for internal cleaning, and a new drill stem is attached for the next day's grouting.

Before shutting down the jet-grouting apparatus, either after completing a normal day's grouting activities or for maintenance, clean grout and wash water will be flushed through the grout circulation system into a storage tank, as described above. Water-and-grout samples will be collected from the cleanout storage tank each time the system is flushed (to establish tracer concentrations) to determine the effectiveness of the positive displacement pump and contamination control equipment. These samples are assumed to be a mixture of the cleanout water and remaining grout material. As many as five water-and-grout samples will be collected and analyzed for tracer compounds.

Approved vendor procedures will be followed during operation and maintenance of the jet-grouting apparatus, however, material collection and disposition may be modified, as necessary. All unused grout and flush water will be discharged into a containment area constructed at the cold test pits. All waste will be segregated and labeled for proper waste disposition, as discussed in the *U.S. Department of Energy-Idaho Operations Office, Idaho National Engineering and Environmental Laboratory Interim Pollution Prevention Plan* (Janke 2000).

#### **1.4.6 High-Volume Air Samplers**

During grouting, approximately seven high-volume (25-cfm) air samplers will be strategically placed around the grouting operation and will run continuously. Equipment calibrations will be performed or approved by the INEEL calibration laboratory and will be guaranteed to  $\pm 10\%$  for total airflow. The filters will be collected from the samplers when the pressure drop across the filter of the samplers requires changeout, in accordance with manufacturer specifications, or at a greater frequency. For a given sampling interval, the filters will be composited and handled as one sample. After individual samples are weighed, the composite filters will be placed in a plastic bag, labeled, and dated. The data will include initial weight ( $\pm 0.1$  mg), total airflow ( $\pm 10\%$  of reading), and final weight ( $\pm 0.1$  mg). Background composites of the seven filters will be collected prior to grouting. Filter material from the HEPA system in the thrust block, thrust block air inlet, and drill string shroud inlets will be collected using sampling techniques similar to those used for the collection of the air samples. In addition, the temperature and humidity under the thrust block will be measured to support HEPA filter evaluations.

#### **1.4.7 Post-Grouting Noninvasive Monolith Evaluation**

After grout emplacement, data will be collected to evaluate:

- Curing temperature of the monolith
- Geophysical monolith verification
- Hydraulic conductivity of the emplaced monolith through emplaced wells.

The data will be collected for evaluation (prior to monolith disturbance) via planned archeological excavation.

#### **1.4.8 Post-Grouting Destructive Examination**

After completion of the hydraulic conductivity tests, the monolith will be exposed for examination and sampling and eventually systematically dismantled. Monolith examination will be used to evaluate the effectiveness of the grouting process. Laboratory analysis of monolith samples will provide data for determining how effectively grout stabilizes for the long term, primarily as a barrier against water infiltration. Monolith sample media also will be collected for long-term coupon studies at the WAG 7 Materials Test Facility. Some of these measurement-of-monolith properties are direct input variables for

the risk assessment model and will be used for calculation of the specific risk reduction, as a function of time, associated with this treatment application.

Following removal of the weather structure, the thrust blocks will be moved. The grout returns under the thrust block will be photographed and qualitatively described. Next, the monolith will be excavated and examined and the top overburden material will be removed from the original boundaries of the pit. Next, the monolith will be isolated, leaving a freestanding entity for further evaluation and sample collection. All excavation tasks will be conducted under the direction of a competent person and in accordance with PRD-22, "Excavation and Surface Penetration." The project safety professional will evaluate the structural stability of the monolith during excavation tasks to determine to what extent each side or face should be exposed, and the access requirements and control methods that will be implemented during observation tasks following excavation. The structural integrity of the monolith will be examined in detail. Because of the dynamic nature of this part of the project and the unknowns involved, it will be the responsibility of the field team leader (FTL) and HSO to determine the best methods for examining the monolith. Soil will be removed in approximately 6-in. (15-cm) increments, exposing the monolith while trying to maintain a nearly vertical face. Personnel from the INEEL will excavate and transport filled drums (i.e., samples) of the monolith with standard heavy equipment (e.g., backhoe, front-end loader, and forklift).

During examination, the monolith will be evaluated for the following:

- Grout permeation (ratio of grout to soil to waste and void presence)
- Degree of bonding between grout and waste
- Monolith cracking and spalling
- Relative degree of mixing of grout and waste, and compaction of waste material caused by grouting
- Areas of set retardation and impeded curing because of interferences
- Zones of incomplete mixing or component separation, especially in the vicinity of the grouted organic and nitrate drums
- Areas of monolith swelling and disintegration
- Penetration of fluorescent dye in the hydraulic conductivity holes to evaluate monolith development and assess implementability and relative grouting effectiveness
- Edge effects between grouted regions and soils surrounding the pit.

The monolith will be assessed for fractures, particularly noting thermal-mechanical stresses, such as:

- Degree of fracture penetration into the monolith
- Fracture zoning and orientations
- Fracture spacing and aperture dimensions.

The specific equipment and materials that will be used during the ISG grouting, excavation, and sampling tasks are further described in the *Implementation Test and Field Test Plan for the Operable Unit 7-13/14 In Situ Grouting Treatability Study* (Loomis et al. 2001).

#### **1.4.9 Monolith Sampling, Site Closure, and Material Storage**

At the conclusion of the field test and associated hydraulic conductivity test, the grouted monolith will be exposed for examination and sampling and systematically dismantled. The entire monolith will be removed for disposal. Following removal, the debris from the destructive examination will be disposed of according to approved INEEL Waste Determination and Disposition Forms (INEEL Form 435.39). Representative samples of grout mixtures will be obtained as described in the Implementation Test and Field Plan (Loomis et al. 2001). The grouted material will be removed from the pits for disposal elsewhere, depending on sampling and analysis results. At that time, solid waste will be generated and the final hazardous waste status determined.

Removal of any contaminated soils will occur in association with the removal of the monolith. Based on the process and surrogate contaminants used, little (if any) cross contamination of perimeter soils is expected. However, adjacent soil will be collected from the pit if visible staining or evidence of surrogate material migration is present. The retrieved soil volume will be randomly sampled, composited, and analyzed to verify nonoxidizing properties before disposal (e.g., using a U.S. Department of Transportation solid oxidizer test).

### **1.5 Additional Activities**

Ancillary activities that will be performed prior to the start of ISG activities include:

- Prepare or revise existing National Environmental Policy Act documentation, including an environmental checklist (as required)
- Prepare or revise existing construction storm water pollution prevention plan, as necessary
- Prepare work control documentation and integrated planning sheets in accordance with STD-101, *Integrated Work Control Process*
- Complete a hazards screening checklist and job walk-down
- Prepare a job safety analysis
- Revise existing unreviewed safety questions to the *RWMC Safety Analysis Report* (INEEL 2000a), as required.